Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Parts 1, 2, 15, 74, 78, 87, 90, and 97	)	**ET Docket No. 12-338**
of the Commission's Rules Regarding	)	
Implementation of the Final Acts of the World	)	
Radiocommunication Conference (Geneva, 2007)	)	
(WRC-07), Other Allocation Issues, and Related Rule	)	
Updates	)	

To: The Commission

COMMENTS OF ARRL, THE NATIONAL ASSOCIATION FOR AMATEUR RADIO

1. ARRL, the national association for Amateur Radio, formally known as the American Radio Relay League, Incorporated (ARRL), by counsel and pursuant to Section 1.415 of the Commission's Rules (47 C.F.R. § 1.415), hereby respectfully submits its comments in response to the *Notice of Proposed Rule Making and Order*, FCC 12-140, 27 FCC Rcd. 14598, released November 19, 2012.[1] The *Notice of Proposed Rule Making* portion of that document (the "Notice") proposes to amend, among other things, Parts 2 and 97 of the Commission's rules to implement allocation decisions from the World Radiocommunication Conference (Geneva, 2007) (WRC-07) concerning portions of the radio frequency (RF) spectrum in the Low Frequency (LF) and Medium Frequency (MF) bands. Specifically, *inter alia*, the Notice: (1) solicits comment on whether it should allocate the 135.7-137.8 kHz band to the Amateur Radio

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[1] The Notice was published in the Federal Register on December 27, 2012. 77 Fed. Reg. 76250 *et seq*. Therefore, these comments are timely filed.

Service on a secondary basis[2], but subject to the protection of unlicensed power line carrier (PLC) operations; and (2) proposes to raise the secondary Amateur Service allocation in the 1900-2000 kHz band (100 kilohertz) to primary status. ARRL limits its comments in this proceeding to these two issues. In support of the allocation of the small LF band 135.7-137.8 kHz to the Amateur Radio Service on a secondary basis, and in support of the proposal to upgrade the existing Amateur Radio Service allocation in the 1900-2000 kHz band from secondary to primary status, ARRL states as follows:

I. There is a Strong Justification for a Low- Frequency Allocation for the Amateur Radio Service.

1. The subject of an LF[3] allocation for the Amateur Radio Service has a long history at the Commission. To date, however, the Commission has not created one. Presently, the lowest domestic frequency allocation for the Amateur Service (and the only MF allocation) is at 1800-2000 kHz.[4] There is an Amateur Radio allocation in *all other areas* of the radio spectrum, providing for experimentation in virtually all types of radio frequency communications. Technical self-training and furtherance of radiocommunications development in the Amateur

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[2] The allocation would be secondary to the fixed service and the maritime mobile service domestically and internationally.

[3] The LF frequency range is commonly defined internationally and domestically as the spectrum between 30 kilohertz and 300 kilohertz.

[4] Per Section 97.301 of the Commission's Rules, Amateur stations regulated by the Commission in ITU Regions 2 and 3 are allocated the band 1800-2000 kHz. For stations within ITU Region 1, the band 1810-1850 kHz is available. On November 29, 2012, ARRL filed a Petition for Rule Making seeking to amend Parts 2 and 97 of the Commission's Rules to create a new domestic allocation and new and modified service rules for use by the Amateur Service of the MF frequency band 472-479 MHz. This Petition has not yet been afforded a file number by the Commission. It appears that when filed, it was mistakenly referred to the Media Bureau by the Office of the Secretary. It is hoped that this will be corrected without further delay, as ARRL has repeatedly requested. The Petition should have been referred to the Office of Engineering and Technology.

Service (which is in essence an experimental radio service) would be greatly enhanced by an allocation in the LF portion of the spectrum.[5]

2. The issue of a domestic LF allocation for the Amateur Service first formally arose in connection with the Commission’s preparation for the 1979 World Administrative Radio Conference (WARC). To prepare for that WARC, the Commission issued a series of Notices of Inquiry in Docket 20271. It used the comments received in response to those Notices of Inquiry as the basis for the United States’ WARC-79 proposal. Prior to that docket proceeding, the Commission had established an Advisory Committee for Amateur Radio relative to WARC-79 preparations. The Advisory Committee stated, in a report issued May 18, 1976 at Page 50, as follows:

> There exists among some amateurs a keen desire to conduct experimentation and communication at low frequencies, as well as at vhf and uhf (sic). The FCC authorizes the operation of low power communication devices in the band 160-190 kHz under Part 15, Subpart D, of its rules. Despite the severe restrictions of one watt power input and a total length not to exceed 15 meters, experimenters have been successful in transmitting over paths of several hundred miles under favorable conditions. An Amateur allocation with less severe restrictions in this band, which is now allocated to the fixed service in Region II but is little used outside of Alaska, would permit amateurs to resume experimentation in a portion of the spectrum which has not been available to them for more than 50 years.

Notwithstanding this recommendation and the filing of extensive comments by ARRL in response to the *Fifth Notice of Inquiry* in that docket proceeding, the Report and Order terminating Docket 20271 (FCC 78-849, released December 28, 1978) concluded that the 160-

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[5] A secondary international allocation to the Amateur Radio Service at 135.7-137.8 kHz in all three ITU Regions was adopted in November of 2007 at the 2007 WRC, subject to a one-Watt e.i.r.p. limitation. Amateur operation in several countries has since been authorized, with no reports of harmful interference to the primary services. The United States offered no objection to this international allocation. In ITU Region 2, Canada has allowed its radio Amateurs to operate in the band 135.7-137.8 kHz since December of 2009.

190 kHz band could not be made available to the Amateur Service due to concerns of interference to power line carrier (PLC) systems:[6]

> The radio amateurs were most responsive to the Notices of Inquiry in this Docket. Their attempts to define their spectrum needs as well as to comment on the needs of other radio services provided useful information. Although many of their needs have been accommodated, it has proven impossible to satisfy their desire for a low frequency allocation. Power Line Carrier (PLC) operations and the extreme difficulty of satisfactory frequency coordination due to the unpredictable nature of amateur operations are obstacles to any amateur service allocation being proposed in this spectral range.

3. In 1982, in General Docket 82-9, which was initiated to consider establishment of what is now U.S. Footnote 2 (formerly US294) in the Table of Allocations (for the purpose of recognition of PLC systems and to provide for notification by other users of the LF and MF spectrum to utilities), the Commission stated[7] as follows:

> Based on several comments in the proceeding [which] incorrectly speak of coordination rather than notification and of maintaining existing status of PLC relative to other Part 15 users, the Commission seeks to dispel any misunderstanding concerning the intent of this proceeding. Accordingly, the Commission wants to reaffirm its position that this proceeding does not elevate the status of PLCs in any way and that their operation in the band must be on an unprotected, noninterference basis to authorized users operating under Part 15 provisions. Cooperation between parties to the extent practicable is expected but, in any event, the PLC users must realize that in the event conflicts on spectrum usage cannot be resolved on a cooperative basis, their operation on an unprotected, noninterference basis must adjust to meet the requirements of the authorized radio users.

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[6] Frequencies within the range 9-490 kHz are used by electric companies in the United States for PLC applications. See, 47 C.F.R. § 15.113(b). These systems are used to control and monitor high voltage transmission lines and associated equipment in such applications as automated meter reading, load control, and demand response.

[7] See, *Amendment of Parts 2, 15 and 90 of the Commission's Rules to Provide Recognition for Power Line Carrier Operations of Electric Utilities in the Bands 10-490 kHz,* Report and Order, 48 Fed. Reg. 5922, 52 Pike & Fischer Radio Regulation 2d 1713 (1983).

The language in the footnote[8] was intended to urge, but not require, cooperation in preventing potential interference. The admonition was in the nature of a notification action. The Commission eschewed mandatory language requiring cooperation because "the stricter … language could be misinterpreted to convey that Commission or NTIA intervention for enforcement purposes is expected if parties will not cooperate, a situation which would implicitly elevate the status of PLC operators in an unintended manner." [9] It is important to note in this context that *PLCs do not operate on all power lines*. They operate, per Section 15.3(t) of the Commission's rules [47 C.F.R. § 15.3(t)], by conduction over the electric power transmission lines of the system. The definition in Section 15.3(t) states that "(t)he system does not include those electric lines which connect the distribution substation to the customer or house wiring." Therefore, PLCs are not found in residential areas, where the majority of fixed Amateur Radio stations are located.

4. On October 22, 1998 ARRL filed a Petition for Rule Making[10] seeking LF allocations for the Amateur Service at 135.7-137.8 kHz and 160-190 kHz. The petition noted, with respect to the 135.7-137.8 kHz band, that radio Amateurs in other countries had theretofore been accommodated in that segment. Among those countries were Belgium, Finland, Norway and the United Kingdom. Other countries at the time permitted Amateur Radio experimentation at LF via

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[8] Footnote US2 (formerly, prior to renumbering, US294 which was identically worded) reads as follows:

> In the band 9–490 kHz, electric utilities operate Power Line Carrier (PLC) systems on power transmission lines for communications important to the reliability and security of electric service to the public. These PLC systems operate under the provisions of 47 CFR part 15, or Chapter 8 of the *NTIA Manual*, on an unprotected and non-interference basis with respect to authorized radio users. Notification of intent to place new or revised radio frequency assignments or PLC frequency uses in the band 9–490 kHz is to be made in accordance with the Rules and Regulations of the FCC and NTIA, and users are urged to minimize potential interference to the extent practicable. This footnote does not provide any allocation status to PLC radio frequency uses.

[9] Op.cit*. Amendment of Parts 2, 15 and 90 of the Commission's Rules to Provide Recognition for Power Line Carrier Operations of Electric Utilities in the Bands 10-490 kHz, Report and Order, 48 Fed. Reg. 5922, at ¶12*

[10] RM-9404.

special or experimental authority. Among them were Germany, Iceland, Italy, Luxembourg and Australia. Allocations were pending at the time in France and Sweden. A 1997 CEPT[11] recommendation was the basis for the specific interest in the band 135.7-137.8 kHz in Europe. The justification for the proposed allocation of 160-190 kHz in ARRL's petition was the fact that numerous radio Amateurs and other experimenters were already using that band pursuant to Part 15 rules, which allows operation in that band at up to one watt input power, but with significant antenna size restrictions which severely restrict antenna efficiency, thus severely compromising or precluding the effectiveness of experimentation in that band.

5. The Commission issued a *Notice of Proposed Rule Making* in May of 2002[12] in response to the ARRL Petition, which proposed to allocate the 135.7-137.8 kHz band to the Amateur Service on a secondary basis so as to permit radio Amateurs to experiment "more freely with propagation, antenna design and antenna construction."[13] The Commission also specifically found that "…this allocation appeared to be acceptable because the incumbent use of the 135.7-137.8 kHz band appeared to be very light, and thus a secondary amateur service allocation in this band would likely raise few interference concerns."[14] It was also noted that the use of LF frequencies generally by unlicensed devices was on an "unprotected, non-interference basis" and that PLC systems are permitted pursuant to Section 15.113 of the Commission's rules[15] to

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[11] European Conference of Postal and Telecommunications Administrations Recommendation 62-01 (Mainz 1997).

[12] *Notice of Proposed Rule Making*, FCC 02-136, 17 FCC Rcd. 8954 (released May 15, 2002).

[13] 17 FCC Rcd. at 8962-8963.

[14] *Amendment of Parts 2 and 97 of the Commission's Rules to Create a Low Frequency Allocation for the Amateur Radio Service*, ET Docket No. 02-98, *Report and Order*, 18 FCC Rcd. 10258, 10261 (2003); *recon denied*, 19 FCC Rcd. 6536 (2004).

[15] Section 15.113 presently states as follows:

> Power line carrier systems.
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> Power line carrier systems, as defined in § 15.3(t), are subject only to the following requirements:

operate in the 9-490 kHz segment. Because of concerns related to potential interaction between PLC systems and Amateur stations, the Commission did not propose to allocate the 160-190 kHz band to the Amateur Service. Ultimately, in May of 2003, the Commission declined to create the secondary allocation proposed by ARRL in *either* LF band, citing generalized but technically unsubstantiated concerns in comments filed by the United Telecom Council (UTC) and by an IEEE committee about potential interference to PLC facilities. Those issues are now to be revisited in this proceeding.

II. Reevaluation of the Commission's 2003 Decision With Respect to 135.7-137.8 kHz is Necessitated by the WRC-07 Final Acts, and Because the 2003 Decision Was Not Premised on a Substantiated Technical Analysis of Potential Interaction or Compatibility Between Amateur Radio Operation and PLC Systems.

6. The Commission notes at paragraph 13 of the Notice that the United States (domestic) Table of Allocations specifies that the 130-160 kHz band is allocated to the fixed service (FS)

(a) A power utility operating a power line carrier system shall submit the details of all existing systems plus any proposed new systems or changes to existing systems to an industry-operated entity as set forth in § 90.35(g) of this chapter. No notification to the FCC is required.

(b) The operating parameters of a power line carrier system (particularly the frequency) shall be selected to achieve the highest practical degree of compatibility with authorized or licensed users of the radio spectrum. The signals from this operation shall be contained within the frequency band 9 kHz to 490 kHz. A power line carrier system shall operate on an unprotected, non-interference basis in accordance with § 15.5 of this part. If harmful interference occurs, the electric power utility shall discontinue use or adjust its power line carrier operation, as required, to remedy the interference. Particular attention should be paid to the possibility of interference to Loran C operations at 100 kHz.

(c) Power line carrier system apparatus shall be operated with the minimum power possible to accomplish the desired purpose. No equipment authorization is required.

(d) The best engineering principles shall be used in the generation of radio frequency currents by power line carrier systems to guard against harmful interference to authorized radio users, particularly on the fundamental and harmonic frequencies.

(e) Power line carrier system apparatus shall conform to such engineering standards as may be promulgated by the Commission. In addition, such systems should adhere to industry approved standards designed to enhance the use of power line carrier systems.

(f) The provisions of this section apply only to systems operated by a power utility for general supervision of the power system and do not permit operation on electric lines which connect the distribution substation to the customer or house wiring. Such operation can be conducted under the other provisions of this part.

and maritime mobile service (MMS) on a primary basis for Federal and non-Federal use. It states that Federal use is "light." WRC-07 allocated the 135.7-137.8 kHz band to the Amateur Radio service on a secondary basis in all ITU Regions. RR 5.67A, adopted at WRC-07, restricts the use of this LF allocation to amateur radio stations transmitting with a maximum equivalent isotropically radiated power (EIRP) of 1 Watt. Furthermore, there are no non-Federal stations in the FS and MMS that are licensed to operate in the 135.7-137.8 kHz band. Therefore, the only significant users of this 2.1 kilohertz band segment are utilities which operate PLC systems in the 9 to 490 kHz band, a band which is 481 kilohertz wide.

7. At paragraph 16 of the Notice, the Commission concludes that it is an appropriate time to re-examine the potential for "shared"[16] Amateur Radio and PLC use of the band 135.7-137.8 kHz. However, the Commission states:

> We seek comment on whether the 135.7-137.8 kHz band should be allocated to the amateur service on a secondary basis and restricted in accordance with RR 5.67A. Commenters should address, in particular, any recent developments that would prompt a re-evaluation of the Commission's prior decision.

The international allocation of the 135.7-137.8 kHz band to the Amateur Service on a secondary basis, without more, amply justifies a re-evaluation of the Commission's 2003 decision. Moreover, the 2003 decision of the Commission to not create a new Amateur allocation in that small segment was not based on any quantitative compatibility evaluation.[17] Rather, the

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[16] Because unlicensed devices operated under Part 15 of the Commission's Rules have no allocation status, it is assumed that the term "shared" as used in this context refers to sharing of spectrum in the generic sense only.

[17] In the Report and Order in Docket 02-98, the Commission summarized the utility industry's responses to the 2002 Notice of Proposed Rule Making in that proceeding [*Notice of Proposed Rulemaking*, 17 FCC Rcd 8954 (2002)] as follows:

> The utility companies, UTC, and IEEE, disagree with the arguments of the amateur community and oppose allocating the 135.7-137.8 kHz band to the amateur service on a secondary basis. They are concerned about interference to these systems, and state that PLC systems are critical to the functioning of the national power grid and that amateur operations could cause widespread power

Commission simply balanced the perceived importance of PLC systems against the acknowledged desirability of creating a first LF allocation for the Amateur Service, assuming that there was some interference potential. The interference potential assumption was not, however, premised on any technical compatibility analysis. Though the Commission noted that it was obligated to evaluate in this context the "potential for interference conflicts between (PLC operations and Amateur operations at 135.7-137.8 kHz)", there was nothing in the *Report and Order* released May 14, 2003 indicating that a compatibility evaluation had been conducted;[18] what assumptions had been made in performing any study if one had been conducted; or what data was used.[19] The decision was, instead, limited to an abstract concern expressed by the

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> outages. Public Service Gas and Electric Company (PSG&E) submits that an unplanned trip of a relay could result in instability at several power sites, and that this instability could result in the generating station tripping offline.[17] Pinnacle West indicates that while redundant power schemes are in place, they do not protect against an external signal that causes a false trip. It further states that Frequency-Shift Keyed (FSK) PLC systems are most vulnerable, since the amateur signal could appear on the correct frequency with enough signal strength to exceed the receiver's threshold.[17] In additional (sic), UTC points out that the Commission's analysis on the number and location of PLCs that could be impacted by the proposed action is incorrect. UTC states that most PLCs have a 4 kilohertz wide bandwidth, so that the actual number of PLCs that would be impacted by the proposed new allocation is about 2000, not 430 as indicated in the *Notice*.

Amendment of Parts 2 and 97 of the Commission's Rules to Create a Low Frequency Allocation for the Amateur Radio Service, ET Docket No. 02-98, *Report and Order*, 18 FCC Rcd 10258, 10261 (2003); *recon denied*, 19 FCC Rcd. 6536 (2004).

[18] The record in that proceeding did, however, include extensive showings that there would not be interaction between Amateur stations and any PLC facilities at 135.7-137.8 kHz, except at ranges extremely close to overhead power lines, and that, in such cases, noise from the power lines would preclude Amateur Radio communications in that frequency range. Notwithstanding that record evidence, the Commission merely stated that "We find that separation distances on the order of 950 meters would be necessary to protect the PLCs from interference" and that there would be a "larger than expected number of PLCs potentially impacted by this proposed allocation." Neither of these conclusions was based on any actual field tests, and the possibility of private sector coordination between radio Amateurs and power utilities (via ARRL and UTC, respectively) as a means of interference avoidance was not considered. Nor was the necessity of continued use of the small, 2.1 kHz wide segment by PLCs evaluated or the ability of utilities to modify any which might require mitigation to another portion of the 9-490 kHz band. Finally, there was no estimate made of the number of Amateur Radio licensees likely to utilize the allocation.

[19] The record in that proceeding contained extensive technical interference studies submitted by ARRL and others, which were unrebutted by any comments filed (comments which, themselves, did not contain any technical studies). The basis for the Commission's finding of significant interference potential remains unclear. In any case, the luxury of a *de facto* exclusive PLC use (which is, paradoxically, specifically unprotected from interference by specific rule and by United States footnote) of the *entire LF spectrum and more* is not any longer possible in view of the need to

utility industry about a need for interference-free (yet unlicensed) PLC systems.[20] Nor was the "balancing test" employed by the Commission at the time the proper metric for evaluating an Amateur LF allocation in a 2.1-kilohertz-wide segment of the 9 kHz to 490 KHz band used by PLCs. According to UTC, PLCs utilize 4 kHz of occupied bandwidth per device. [21] The question therefore (assuming *arguendo* that there had been some *demonstrated* incompatibility between PLC-carrying transmission lines and Amateur stations in the 135.7-137.8 kHz band where the two were in very close geographic proximity), was how burdensome it would have been for the utilities to avoid use of this small band segment, given the residual availability of 478.9 kHz of alternative spectrum for PLCs at LF. This question was neither asked nor answered in Docket 02-98. It is timely to address it now.

8. At paragraph 17 of the instant Notice, the Commission now asks some of the questions that should have been asked in 2002. It states that, because PLC systems operating under Section 15.113 of the Commission's Rules serve functions such as tripping protection circuits if a

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accommodate new uses, and in order to accomplish the implementation domestically of a worldwide allocation to the Amateur Service in a *very* small segment of the 481 kHz now available at LF and MF to PLC systems.

[20] *Id.* At Paragraph 16 of the Commission's 2003 *Report and Order*, it was concluded as follows:

> While we agree that amateur experimentation in the 135.7-137.8 kHz and 160-190 kHz portions of the LF spectrum could serve to increase the pool of individuals having knowledge of LF transmissions, we conclude that such operations would pose the potential for harmful interference to systems protecting and controlling the national power grid. Therefore, we find that a new amateur allocation in the LF range of the radio spectrum is not justified when balanced against the greater public interest of an interference-free power grid.

[21] This was verified by a 2002 article in IEEE Transactions on Power Delivery entitled *Evaluation of the Potential for Power Line Carrier (PLC) to Interfere With Use of the Nationwide Differential GPS Network* (Silva, Michael, Senior Member, IEEE and Whitney, Bruce, Member, IEEE), Volume 17, No. 2, April, 2002. In that article, the operating bandwidth of PLC transmitters (defined as that within 3 dB of the peak response) is stated to be generally less than 3.4 kilohertz. The same IEEE article stated that, of the 28,816 PLC transmitters that reportedly existed in March, 1999 in the United States, 8,788 operated in the band 100-150 kHz. Even if all of those PLC transmitters that operated *somewhere* in the 100-150 kHz band in 1999 are still operational, and even if any of those which were operating in 1999 and which are still operational now are presently operating in the 2.1 kHz segment 135.7-137.8 kHz, it would surely be reasonable for utilities to retune those very few PLC transmitters less than 4 kilohertz, which is *less than 1 percent of the available operating frequencies for PLC systems at LF and MF*.

downed power line or other fault is detected in the power grid, the Commission would only consider adding an amateur allocation if it is “comfortable” that Amateur Radio and utility PLC systems could successfully co-exist in “the band” (sic). It is unclear from the Notice whether “the band” refers only to the 135.7-137.8 kHz band, or whether the reference is to the entire 9-490 kHz band utilized to varying degrees by PLCs. The Notice asks whether there are other segments within the 9-490 kHz band where use by Amateur stations would be a “better fit” from a spectrum sharing viewpoint. However, it is reasonable to ask also, under the circumstances, whether PLC systems could avoid use of the 2.1 kHz segment at 135.7-137.8 kHz, and to make use of the large amount of remaining spectrum between 9 kHz and 490 kHz (other than 472-479 kHz) instead, thus insuring compatibility following allocation of 135.7-137.8 kHz to the Amateur Radio Service. In any event, paragraph 17 of the Notice seeks comment on technical rules or methods that could be implemented to assure compatibility. It also asks how other administrations accommodate Amateur Radio use of this band, and whether there are differences in PLC systems deployment that might make those models more or less useful in the United States.

9. ARRL has no information regarding the differences in PLC systems deployed in different countries, or the extent to which PLCs utilize 135.7-137.8 kHz. Presumably, other parties are in a better position to respond to the Commission’s request to provide this information. Indeed, if other parties oppose the domestic implementation of this international Amateur allocation, it is incumbent on them to explain why it is not possible to do so in the United States when it has been possible for other countries to do so successfully. Use of the band 135.7-137.8 kHz by radio Amateurs is now widespread in Europe and Japan. Other segments

within the 9-490 kHz band are neither a "better fit" nor an adequate substitute[22] for 135.7-137.8 kHz for Amateur operation.[23] It is not clear whether there are other portions of the 9-490 kHz band which are a better fit for PLC operation than the 135.7-137.8 kHz segment. The rationale for the international allocation of 135.7-137.8 kHz to the Amateur Service as described in the CPM Report to WRC-07[24] included the benefit of worldwide harmonization, among other things:

> **Reasons:** A secondary allocation to the amateur service in the frequency band 135.7-137.8 kHz would harmonize on a worldwide basis the use of this band.
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> **Advantages:** A secondary allocation to the amateur service in the frequency band 135.7-137.8 kHz would:
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> – be in harmony with similar allocations that have been approved or are being sought in North America, Europe, Australia, New Zealand and part of Asia;
> – provide radio amateurs with the opportunity to participate in and contribute to a new aspect of radiocommunications which would be consistent with the basis and purpose of the amateur service and would further the self-training in the radio art that is a principal obligation of the amateur service;
> – provide an opportunity for experimentation with equipment, techniques, antennas and propagation phenomena in an interesting frequency band heretofore unavailable to the amateur service;

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[22] An international MF allocation to the Amateur Radio Service at 472-479 kHz was adopted at the 2012 WRC, with an e.i.r.p. limitation of five watts for most of the world.[22] The Final Acts of WRC-12 became effective on January 1, 2013. The allocation was made in fulfillment of WRC-12 agenda item 1.23, considering a secondary allocation to the Amateur Radio Service in the range 415-526.5 kHz. ARRL's Petition for Rule Making to implement this allocation domestically is discussed hereinabove in Footnote 4, *supra.* The 472-479 kHz band is an MF allocation, however. It is unrelated to, and not a substitute for the LF worldwide allocation made at WRC-07 for the Amateur Service.

[23] Since the secondary international allocation to the Amateur Radio Service at 135.7-137.8 kHz in all three ITU Regions was adopted *more than five years ago* at the 2007 WRC, Amateur operation in several countries has since been authorized, with no reports of harmful interference to the primary services. *The United States offered no objection to this international allocation*. In ITU Region 2, Canada has allowed its radio Amateurs to operate in the band 135.7-137.8 kHz since December of 2009. Other countries that have implemented this Amateur allocation include Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Finland, France, Hungary, Iceland, Ireland, Italy, Lithuania, Netherlands, Norway, Russia, Spain and the United Kingdom.

[24] CPM Report on Technical, Operational and Regulatory/Procedural Matters to be Considered by the 2007 World Radiocommunication Conference (Geneva, 2007).

– provide an opportunity for experimentation of potential benefit to other services in keeping with the amateur service's tradition of contributing to the development of radiocommunication techniques and practices; and

– recognize the value of experimentation in attracting young people to the amateur service.

Disadvantages:

– None foreseen.

WRC-12 allocated 472-479 kHz to the Amateur Service on a similar basis to the WRC-07 CPM Report quoted above relative to 135.7-137.8 kHz. However, because of significant differences in the propagation characteristics of these two frequency bands, one does not substitute for the other in terms of Amateur Radio experimentation (a fact which obviously has been recognized internationally). The two bands exhibit different propagation characteristics. While ground wave propagation is predominant below 500 kHz, skywave propagation can be a factor at 472-479 kHz. The same is not true at 135.7-137.8 kHz. The two bands are not equivalent; nor should they be considered alternative allocations domestically. That said, if there is a sound technical basis for a conclusion that a different segment *in the frequency range 130-160 kHz* is substantially more suitable as an Amateur Service LF allocation in the United States than 135.7-137.8 kHz from a compatibility perspective, ARRL would not object to consideration of such an alternative LF allocation, provided that the alternative segment is at least functionally equivalent.

10. At paragraph 18 of the Notice, the Commission asks for comment on the advantages and disadvantages, and other costs and benefits associated with an Amateur Radio secondary allocation at 135.7-137.8 kHz. Specifically, it asks what benefits might accrue to the amateur radio community from the allocation. The benefits to the Amateur Radio community are as explained above. While there are more than 710,000 FCC amateur licensees, only a small minority is expected to pursue LF experimentation. However, it may be anticipated that their

experiments will lead to advances in the detection and decoding of weak signals in the presence of ambient noise and in the design of antennas that are physically small in terms of wavelength. These advances will benefit the larger Amateur Radio community and contribute to radio technology generally. The band also offers a unique environment for propagation experimentation that cannot be duplicated in any other current Amateur Radio allocation. The Amateur Service allocations were initially and still are intentionally interspersed throughout the radio spectrum so as to permit an opportunity for experimentation in *all* portions of the radio spectrum. Notably absent, however - purely for historical reasons[25] - is an LF allocation, never created. *This is the only portion of the radio spectrum in which Amateur Radio operators have never been afforded the opportunity to conduct self-training and courses of experimentation with propagation and equipment.*

11. The Commission asks for information about the extent to which utilities deploy PLC systems on distribution lines in the 9-490 kHz band, and how those operations would be affected by a new secondary amateur radio service allocation in “this band”. It asks what specific actions PLC systems operators would take if there were a secondary amateur radio service allocation in the band, and what the associated costs would be. ARRL has no specific information with regard to these two questions and is looking forward to reviewing the responses offered on behalf of PLC systems operators. The ARRL is gratified that the Commission is requesting specific information from utilities in this respect. Indeed, these are questions never asked nor answered in 2003. ARRL trusts that unsupported claims and vague generalities will be

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[25] Amateur Radio operators were relegated initially to frequency bands perceived to be commercially less useful than those LF and MF frequency bands that were heavily utilized (almost exclusively) in the distant past. The situation is now completely different; but the domestic allocation table has not been modified heretofore to take the changes into account.

afforded no weight in the decision making process and that factual assertions will be documented. This Commission has repeatedly noted that sharing of spectrum is necessary now and in the future, to maximize efficient deployment of this limited resource.[26] PLC operation represents an exceptionally *inefficient* use of the entirety of the 9-490 kHz band, to the extent that it is allowed to preclude any other use of that large band, given the extremely low level of band occupancy overall. Consistent with the Commission's spectrum policy, the utilities should be expected to make necessary accommodation for this small Amateur Radio allocation, though as discussed *infra*, very little accommodation should be necessary by utilities.

12. At paragraph 19 of the Notice, the Commission asks whether the concept of requiring individual amateur stations to be "quasi-coordinated" for fixed use at a specified location is necessary or useful as a means of insuring compatibility between PLCs and Amateur stations. Because the frequency band under consideration is very narrow and the number of Amateurs likely to pursue experimentation in the band is limited,[27] the probability of an Amateur station

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[26] See, e.g. *Winning the Global Bandwidth Race: Opportunities and Challenges for Mobile Broadband*, Remarks of FCC Chairman Genachowski at the University of Pennsylvania – Wharton, Philadelphia, PA October 4, 2012:

> "…You can think of spectrum as an essential natural resource. But like many of our natural resources, spectrum is finite, at least with current and foreseeable technologies. Just as we must pursue future-oriented energy technologies and policies, we have no choice on our airwaves: we must make better, more efficient use of spectrum.
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> We know that it is becoming increasingly difficult to find free and clear blocks of spectrum. But there's some good news. Since we wrote our National Broadband Plan, yes, data demand has increased even more than expected, but we've also identified a new source of spectrum supply, enabled by technology and by cooperation among parties: spectrum sharing.
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> If we can share spectrum meaningfully, it will have a dramatically positive effect…
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> For some time, both major commercial and government spectrum users agreed on one thing: that exclusive use should be the sole model for licensed spectrum, and that sharing shouldn't even be tried. But that is changing, and this change is good.

[27] All equipment and antennas for use in this band must be built by the radio Amateur, as little or none is available commercially at this time.

operating in the band being located near a transmission line which hosts a PLC system that uses a frequency in that band segment is very low. ARRL is not aware of any reports of interference to PLC systems arising from operation conducted pursuant to numerous Part 5 experimental licenses issued by the Commission to radio Amateurs in the large band utilized by PLCs. Should the Commission nevertheless conclude that "quasi-coordination" is necessary as a precondition for amateur utilization of the allocation, ARRL must insist that there be provisions to ensure that any actual coordination is not unreasonably withheld by the representative(s) of utilities acting as the coordinator.[28] Within 30 days of submitting the required information about his or her planned operation, the amateur must receive one of two things: clearance to proceed (or negative-option approval), or an explanation with a technical justification of any required modification of the planned Amateur operation.[29] In any case, as is discussed hereinbelow, it is demonstrated in Annex 1 attached hereto that there is no risk of interference *at all* from Amateur stations to PLC-carrying transmission lines using the 135.7-137.8 kHz band at 1 Watt EIRP, where the geographic separation between the two is 1 kilometer or more. Even within that range, the likelihood of interference is exceptionally low. Given this, *coordination or notification would have a purpose only with respect to those Amateur stations located closer than 1 kilometer to a transmission line carrying PLC.*

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[28] A complicating factor is that it is unlikely that utilities will want to disclose to ARRL the location or operating frequencies of PLC systems, so actual coordination is practically impossible. A notification process would have to be utilized instead, whereby notification of fixed Amateur Radio operation at a given location in the band would be given to a representative of utilities in advance of commencement of operation of the Amateur LF station. It is highly anomalous that a licensed radio service would under this scenario be providing notification to an unlicensed radio service with no allocation status at all.

[29] It is suggested that a notification procedure would be more appropriate in this context, if any process is required at all. Footnote US2 makes it clear that PLC systems operating in this band are unprotected, and it would be anomalous for the Commission to require notification of a licensed service's operations to a representative of users of unlicensed, unallocated low power RF devices. However, it could be practical in this instance to implement a limited notification plan due to the anticipated low level of amateur occupancy of this band overall; its nominal bandwidth; and the resultant exceptionally low likelihood of location of an Amateur Station experimenting with LF communications being located at distances of less than 1 kilometer from a power line carrying PLC in that small frequency segment.

13. The Commission asks if there are other steps, such as limiting operating privileges in the frequency band (e.g., to Amateur Extra Class licensees), that would better facilitate Amateur use of the 135.7-137.8 kHz band. While Amateur experimenters in the LF band are more likely than not to hold Amateur Extra Class licenses, ARRL would prefer that operating privileges in this frequency band not be limited to Amateur Extra Class licensees. Amateur Extra, Advanced, and General Class licensees are afforded operating privileges with all emission types in all frequency bands that are allocated to the Amateur Service, with certain frequency limitations on Advanced and General Class licensees in the most popular bands. Thus it would be consistent with Commission policy to make this frequency band available to Amateur Extra, Advanced, and General Class licensees. Technician and Novice class licensees have more limited frequency privileges and it would be unlikely that any significant number of those licensees, if any, would choose to utilize this band as a practical matter.

III. There is No Incompatibility Between PLC Systems and Amateur Station Operation in the 135.7-137.8 kHz Band.

14. At paragraph 19 of the Notice, the Commission asks for comment on the appropriate maximum field strength level and minimum separation distance from PLC systems for Amateur Service operation in this band. Assuming for the moment that there is some compelling reason why PLC systems must continue to operate in the 135.7-137.8 kHz band as opposed to other portions of the 9-490 kHz band, it is apparent from the attached Annex 1 to these comments that there is not any interference potential whatsoever from Amateur stations at 135.7-137.8 kHz to PLC systems carried on transmission lines upstream from distribution substations at separation distances greater than 1 kilometer from the transmission line carrying PLC signals. Distance separation of less than one kilometer would therefore be an appropriate trigger for any regulatory limits other than EIRP. The need for any restrictions on Amateur stations located closer to

transmission lines carrying PLC signals[30] than one kilometer should be evaluated based on the probability of interference.

15. As noted in Annex 1 hereto, the NTIA TR-85-181 Study[31] has evaluated the compatibility of PLC systems and relatively high-powered licensed transmitters operating in the same frequency range as PLC systems. When the methodology of that study is applied to proposed amateur allocations at 135.7-137.8 kHz, the potential for interference is determined to be very low, and the only area for concern is those Amateur stations that may be located closer than 1 km to an existing transmission line carrying PLC signals in that frequency range. At distances of 1 kilometer or greater, Amateur Radio operation at the 1-watt EIRP level co-channel will create signal strengths *at least 6 dB lower* than the field intensity that the NTIA determined would allow PLC systems to function reliably in the presence of licensed emitters. The same 6 dB margin can be achieved at distances closer than 1 kilometer by limiting the transmitted field intensity to 74.8 dBu/m at the location of a power transmission line carrying PLC signals in this frequency range. This 6 dB safety margin is based on worst-case assumptions. The polarization difference between Amateur Radio vertical antennas that will typically be used on this band and horizontally configured power lines would provide an additional margin of interference protection. Therefore, based on the (reasonable) assumptions of NTIA Study TR-85-181, amateur operation at the 1W EIRP level will not cause interference to PLC systems used on transmission lines at separation distances at or beyond one kilometer. To preclude any adverse interaction in those rare instances in which an Amateur LF station would be located closer to a transmission line carrying PLC signals than one kilometer, the rules could

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[30] It is important to note in this context that a separation distance of Amateur stations is *not* required from *all* power lines, or even all transmission lines, but only those few transmission lines on which PLC systems are operating within this 2.1-kHz bandwidth.

[31] Andrew Farrar et al., Evaluation Techniques—Fixed Service Systems to Power-Line-Carrier Circuits; NTIA Report 85-181 (1985).

provide for reduction in the permitted field strength when measured at the transmission line, or require advance coordination with the utility involved.

16. Notwithstanding the above, ARRL reiterates that the likelihood of an Amateur station conducting operations in the band 135.7-137.8 kHz from a fixed station located closer than 1 kilometer from an PLC-carrying transmission line upstream from a distribution substation is so low that a notification requirement would suffice for those instances. Should the notified party object based on substantial, quantitatively documented interference concerns, the radio Amateur would be expected to work with the utility to reach an accommodation that does not involve disruption of the PLC system operation. However, the available remedies in such rare circumstances should include use by the utility of alternate frequencies for the PLC system as well as technical solutions involving the Amateur station.

17. It is suggested that an "exclusive use" model for the entire LF and lower MF spectrum, favoring PLC unlicensed, unprotected operations and excluding other applications entirely is unjustified and unjustifiable now (if in fact it was justifiable at any time in the past).[32] There has been, since the 2003 *Report and Order* in Docket 02-98, an intervening, worldwide allocation created in an exceptionally small segment within the LF spectrum that was specifically intended to provide for harmonized, worldwide use and experimentation by radio Amateurs. A large and increasing number of European countries have permitted Amateur Radio use of this small segment for many years, and a large number of administrations, including Canada now permit their radio Amateurs to utilize the segment. It is suggested that, with the proper "spectrum etiquette" as recommended internationally, there can be implemented a fully

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[32] See, Hohn, J.W., et al., *Power Line Carrier Practices and Experiences,* IEEE Transactions on Power Delivery, Vol. 10, No. 2, April 1995 (Survey of power utilities shows that authorized RF systems are not an interference problem for PLC systems; PLC system operators have little concern about interference from licensed systems; 88 percent of surveyed utilities report no interference problems from LF stations.)

compatible spectrum overlay of Amateur Radio operation in the 135.7-137.8 kHz band by implementing the domestic allocation proposed herein. To the extent that PLC systems are still in place that actually utilize this segment at the present time, the One-Watt EIRP and 200-Watt PEP[33] transmitter output power limitations be implemented in the aggregate that will allow compatible sharing with unlicensed PLC operation. It is also possible for PLC systems to notch, or make no use of this small segment of the 9-490 kHz band, because the current state of the art for PLC systems permits frequency agility. Furthermore, as is discussed below, PLC systems are required by Commission rule to comply with industry standards for immunity. If that rule is complied with, current immunity standards will virtually insure against any interaction between Amateur stations operating at LF (or MF) as proposed herein.

18. In this respect, it is instructive to note that the PLC systems internationally utilize "listen-before-transmit" protocols. Pursuant to CENELEC[34] international standards, the lower part of the frequency range 9-490 kHz is segmented. Under the applicable CENELEC standard, 3 to 95 kHz is designated for "utility" use (Band A). Band B, 95-125 kHz, is designated for consumer use. Band C, which includes135.7-137.8 kHz, is designated for consumer use, with a mandated carrier-sense, multiple-access protocol (CSMA).[35] This requires that the PLC devices are mandated to listen before transmitting, to avoid interference between devices or to sensed carriers from external sources, such as licensed radio services. The fact that these devices are mandated to wait some unspecified period of time before transmitting in this part of the band

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[33] See, Annex 1 attached hereto and the discussion of Amateur operating parameters, *infra*.

[34] CENELEC, the European Committee for Electrotechnical Standardization, is responsible for standardization in the electrotechnical engineering field. CENELEC prepares voluntary standards, which help facilitate trade between countries, create new markets, cut compliance costs and support the development of harmonized worldwide markets.

[35] CSMA is a probabilistic Media Access Control protocol in which a node verifies the absence of other traffic before transmitting on a shared transmission medium, such as a frequency band segment.

means that the only applications that can be put there are those that can tolerate having to wait occasionally without causing significant harm to the desired operation of the device or system.

IV. Nominal Service Rule Limitations on Transmission Bandwidths, Transmitter Power Outputs and Antenna Heights Utilized by Amateur Radio Operators at 135.7-137.8 kHz are Appropriate.

19. The Notice, at footnote 40, discusses the Commission's 2002 proposal in ET Docket 02-98 to limit Amateur transmission bandwidths to 100 Hz, and to limit transmitter output power to 100 Watts, as an easily measurable means to limit effective isotropic radiated power (EIRP) to 1 Watt or less (the limit established for Amateur operation at WRC-07 in RR 5.67A). The appropriate power limitation in this band in order to insure compatibility with PLC operations is set forth in Annex A attached hereto. ARRL interposes no objection to a reasonable limit on transmitter output power in addition to the 1 W EIRP limit set out in RR 5.67A. However, a limit of 200 W PEP output would be consistent with the existing §97.313(c) of the Commission's rules and therefore could be incorporated into the Rules somewhat more easily. Because in any case, 1 W EIRP would be an absolute limit, the specification of a limit of 200 W PEP output in the Part 97 rules would have no effect at all on the interference potential of Amateur Stations with respect to PLCs. As to the issue of transmission bandwidth, ARRL knows of no rationale for limiting occupied bandwidth by rule to less than 2.1 kHz, and suggests that such a limit is not necessary. Nor is it conducive to experimentation with narrowband data emission modes in the future.

20. At footnote 44 of the Notice, the Commission states that, whether or not UTC is willing to assist the Commission with its suggested 'quasi-coordination' process, the Commission believes that, as an initial matter, it would be helpful to generally limit the vertical antenna height of Amateur stations transmitting in the 135.7-137.8 kHz band to 60.96 meters

(200 feet) and "to also consider the low efficiency of antennas in this band." ARRL has no objection to this proposed limit on vertical antenna height. It is agreed that the low efficiency of antennas should be taken into account in assessing the necessity of "quasi-coordination" or other regulatory provisions that would affect amateur utilization of the allocation within 1 km of a transmission line carrying PLC signals.

V. A Primary MF Allocation at 1900-2000 kHz for the Amateur Service is Necessary and Appropriate.

21. The other issue addressed in the Notice of great interest to Amateur Radio licensees is the proposed upgrade of the existing secondary Amateur Service allocation in the upper half (i.e. 1900-2000 kHz) of the 160-meter band (1800-2000 kHz) to primary status. As the Commission explains, the Amateur 160-meter band presently consists of two segments: The 1800-1900 kHz subband is allocated to the Amateur Service on an exclusive basis. The 1900-2000 kHz band is now allocated to the radiolocation service on a primary basis for Federal and non-Federal use, and to the Amateur Service on a secondary basis under the terms of Footnote US290.

22. The Commission notes that in the past, the Amateur Service was allocated the entire 1715-2000 kHz band on an exclusive basis. The 1715-1800 kHz segment was reallocated in 1953. Thereafter, until 1983, the 1800-2000 kHz band was allocated to the Amateur Service on a shared basis with the radionavigation service. In 1983, the Commission allocated the 1800-1900 kHz band to the Amateur Service on an exclusive basis, and the 1900-2000 kHz band to radiolocation on a primary basis for Federal and non-Federal use and, pursuant to Footnote

US290, to the Amateur Service on a secondary basis.[36] The purpose of allocating 1900-2000 kHz to the radiolocation service was to provide relocation spectrum for radiolocation stations that would be moved out of the 1605-1705 kHz band when expanded-band AM broadcasting would be implemented in that band. As of July, 2012, however, the Commission's Universal Licensing System (ULS) database showed no non-Federal radiolocation licensees at 1900-2000 kHz.[37]

23. This is not surprising, because at the time of the 1983 reallocation, the Second Report and Order in the WARC-79 Implementation docket noted that the 1900-2000 kHz band was not available as *additional* spectrum for radiolocation needs generally, but only for *reaccommodation* of displaced licensees from 1605-1705 kHz.[38] Thereafter, alternatives to narrowband MF radiolocation developed and, as ARRL predicted in 1983, GPS and other technology, which had inherently greater reliability and spectrum efficiency rendered displacement spectrum for MF radiolocation systems unnecessary.

24. The Notice proposal reports that Federal use of the 1900-2000 kHz band is "light," and that there are only 10 assignments authorizing Federal operations of any type in this band. A single Federal assignment authorizes radiolocation to transmit on 1922 kHz using a necessary bandwidth of 600 hertz (Hz) within a protected radius of 193 kilometers (km) centered on San

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[36] Amendment of Part 2 of the Commission's Rules Regarding Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979, General Docket 80-739, *Second Report and Order*, 49 FR 2358, 2360 paras. 21 and 24 (Jan. 19, 1984) (*WARC-79 Second R&O*).

[37] Specifically, on July 20, 2012, Commission staff conducted a review of the 1900-2000 kHz band using the Commission's ULS database and found no active call signs.

[38] *Op. cit.* WARC-79 Second R&O at para.24.

Diego, California.[39] All other Federal assignments in the 1900-2000 kHz band are for unallocated uses, so those assignments operate on an unprotected and non-interference basis.

25. Since 1984, Footnote US290 to the Table of Allocations has left the future status of the Amateur allocation at 1900-2000 kHz vague. It currently reads as follows:

> In the band 1900-2000 kHz, amateur stations may continue to operate on a secondary basis to the radiolocation service, pending a decision as to their disposition through a future rule making proceeding, in conjunction with the implementation of the standard broadcasting service in the band 1625-1705 kHz.

Now, since the relocation of displaced radiolocation stations has been a moot point for at least thirteen years following the full implementation of the AM Expanded Band in the United States as a regulatory matter in 2000, it is timely to remove this outdated footnote and to restore to the Amateur Service access to the entire 1800-2000 kHz band in the United States on a primary basis. This band is capable of and is used for worldwide, skywave and groundwave Amateur Radio communications. It is exceptionally heavily used, especially during protracted sunspot minima. It is at present the only MF Amateur Radio allocation and it will continue to retain its popularity irrespective of the outcome of the ARRL Petition referenced in footnote 4 above.

26. Therefore, ARRL supports the Commission's proposals, to (1) amend the U.S. Table of Allocations to remove the Federal and non-Federal radiolocation allocations from the 1900-2000 kHz band; (2) to raise the secondary Amateur Service allocation to primary status in that band segment; thus to restore the exclusive allocation to the Amateur Service that it historically enjoyed; (3) to delete US290 from the list of U.S. footnotes in the Table of

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[39] Should NTIA require recognition of the single remaining Federal radiolocation facility in San Diego, California as a grandfathered Federal use, ARRL would work with NTIA to accommodate necessary protocols to accommodate that single operation going forward. ARRL understands that after a Report and Order becomes final in this proceeding, the other low-power Federal assignments would operate in this band (if at all) on an unprotected and non-interference basis.

Allocations; (4) to delete the 1900-2000 kHz band and limitations that pertain only to that band from the Radiolocation Service Frequency Table in Section 90.103(b) of the Commission's rules; and (5) to amend Section 97.303 by revising paragraph (c) thereof to remove the 1900-2000 kHz segment from the list of frequency segments that are allocated to the radiolocation service in the United States and other nations.

27. However, the retention of paragraph (g) of Section 97.303 of the Rules, either in its current form or modified as the Commission has proposed, is inappropriate and unnecessary.[40] The Commission proposes to modify that subsection of the Amateur Service rules by listing, by ITU Region, where Amateur stations transmitting in the 160 meter band must not cause harmful interference to, and must accept interference from, stations authorized by other nations. This provision creates a redundancy and it should not be enacted as proposed. Section 97.303(g) presently reads as follows:

> *****
>
> (g) Amateur stations transmitting in the 1900-2000 kHz segment must not cause harmful interference to, and must accept interference from, stations authorized by other nations in the fixed, mobile except aeronautical mobile, and radionavigation services.
>
> *****

The Commission's action in this proceeding as proposed is simply to delete the radiolocation allocation from the domestic Table of allocations. The proposed service rule changes to Part 97 should have implemented that action and not otherwise. However, that is not what is proposed. Instead, the Commission proposes to incorporate unilateral international protection obligations to Subsection (g) of Section 97.303, relative to the entire 1800-2000 kHz band. These are (1) unnecessary relative to the action taken in this proceeding; (2) redundant relative to Section

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[40] *See*, the Notice at Appendix D, Part 97 rules revisions, Section 97.303(g).

97.303(a) of the Amateur Service rules; and (3) significantly and unjustifiably more restrictive with respect to United States radio Amateurs than international obligations require. The Commission should simply delete the entire text of the current Section 97.303(g) as no longer applicable. The Amateur Radio Service is primary in the international Table of Allocations in ITU Region 2. As such, there is no obligation to protect other primary services in other countries that is greater than the obligation of other primary services in other countries to protect the Amateur Service in the United States. That reciprocal obligation is correctly stated in Section 97.303(a). It is incorrectly incorporated in the proposed Section 97.303(g).

28. The Notice proposes the following language for Section 97.303(g):

> **§ 97.303 Frequency sharing requirements.**
>
> * * * * *
>
> (g) Amateur stations transmitting in the 160 m band must not cause harmful interference to, and must accept interference from, stations authorized by other nations as follows:
>
> (1) In Region 1: The radiolocation service in the 1800-1810 kHz segment and the fixed and mobile except aeronautical mobile services in the 1850-2000 kHz segment. In the countries listed in footnote 5.93 (of 47 CFR 2.106), the fixed and land mobile services in the 1800-1810 kHz segment, and in the countries listed in footnotes 5.98 and 5.99, the fixed and mobile except aeronautical mobile services in the 1810-1830 kHz segment.
>
> (2) In Region 2: The fixed, mobile except aeronautical mobile, radiolocation, and radionavigation services in the 1850-2000 kHz segment.
>
> (3) In Region 3: The fixed, mobile except aeronautical mobile, and radionavigation services.
>
> * * * * *

Footnote 58 of the Notice affirms that the entire 1800-2000 kHz band is allocated to the Amateur Service on a primary basis in ITU Regions 2 and 3, but notes that there are other allocations in portions of the band in Region 1, and the fact that the Amateur allocation is not *exclusive* in all ITU regions. It states that, while "the 1800-1850 kHz segment in ITU Region 2 and the 1830-1850 kHz segment in ITU Region 1 are allocated exclusively to the amateur service, the entire 160 meter band in ITU Region 3 and all other segments in ITU Regions 1 and 2 are shared with other radiocommunication services. Because of the large distances that signals in the 160 meter band can propagate, and because of the requirement that stations 'operate so as to not cause harmful interference to any service of the same or higher category in the other ITU Regions or sub-Regions,' we have reflected the allocations in each of the Regions and sub-Regions in the proposed revision of Section 97.303(g)." However, these limitations are duplicative of Section 97.303(a) of the Commission's Rules, which is unchanged in this proceeding and which reads as follows:

> (a) Where, in adjacent ITU Regions or sub-Regions, a band of frequencies is allocated to different services of the same category (i.e., primary or secondary services), the basic principle is the equality of right to operate. Accordingly, stations of each service in one Region or sub-Region must operate so as not to cause harmful interference to any service of the same or higher category in the other Regions or sub-Regions.

In fact, the proposed Section 97.303(g) imposes unilateral protection requirements on United States radio Amateurs without incorporating the "basic principle of equality of right to operate" referred to in Subsection (a). Therefore, the proposed Section 97.303(g) actually adds restrictions to United States' radio Amateurs operating anywhere in the 1800-2000 kHz band that are not called for or justified by the Radio Regulations. It is noteworthy as well that the restrictions listed in the proposed modifications to that rule section are not duplicated with respect to other HF or VHF primary Amateur allocations which have similar international propagation characteristics.[41] Accordingly, ARRL strongly urges the Commission to simply delete the text of the current Section 97.303(g) and to not adopt the proposed revised wording set forth in Appendix D to the Notice.

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[41] Note that the 10.1-10.15 MHz band is allocated on a secondary basis to the Amateur Service internationally (though on a primary basis domestically), so Section 97.303(d) of the Rules offers no relevant instruction with respect to the 1800-2000 kHz band.

VI. Conclusions.

29. ARRL respectfully requests that the Commission create a domestic LF Amateur Radio allocation at 135.7-137.8 kHz, conforming to the allocation status and limitations set forth in the international Radio Regulations. With a 1-Watt EIRP limitation, a 200-watt PEP transmitter power output limitation, and a 200-foot maximum antenna height, ARRL represents that there is no interference potential to PLC systems operated on an unlicensed basis in that very small segment of the 9-490 kHz band that is available for PLC operation at separation distances of 1 kilometer from the transmission line. Because the frequency band under consideration is very narrow; because the number of PLCs operating in the 2.1 kHz segment that would be used by radio Amateurs is limited; because applicable industry standards call for frequency agility in PLC systems and the incorporation of listen-before-transmit protocols; because the number of amateurs likely to pursue experimentation in the band is quite limited; and because transmission lines carrying PLC communications do not include electric lines connecting the distribution substation to the customer or house wiring, the probability of an amateur station operating in the 135.7-137.8 kHz band being located less than 1 kilometer of a PLC system that uses the same frequency band segment is *very* low. ARRL is unaware of any reports of interference to PLC systems arising from operation conducted pursuant to numerous Part 5 experimental licenses issued by the Commission to radio Amateurs in the large band utilized by PLCs. Should the Commission nevertheless conclude that a notification or “quasi-coordination” procedure (to be conducted in the private sector) is necessary as a precondition for amateur utilization of the allocation, the procedure must be limited to proposed Amateur stations proposed to be located within 1 kilometer of a PLC-carrying transmission line. There must be provisions to ensure that any actual coordination is not unreasonably withheld or that the entire burden of insuring

compatibility is placed on the Amateur Radio licensee. Within 30 days of submitting the required notification about his or her planned operation, the radio Amateur must receive one of two things: clearance to proceed, or an explanation with a technical justification of any proposed modification of the planned Amateur operation at that location.

30. It is also timely and urgent that the outdated regulatory provisions for reaccommodation of displaced MF radiolocation stations from 1605-1705 kHz to the 1900-2000 kHz band be removed, and that the Amateur Radio primary allocation be restored in that upper half of the important 160-meter allocation. ARRL supports the proposed revisions to the domestic Table of Allocations proposed in the Notice, and, other than with respect to the proposed modified Section 97.303(g) of the Rules, supports the proposed service rule changes to implement the deletion of the 1900-2000 kHz radiolocation allocation from the domestic Table of Allocations. However, ARRL strongly urges the Commission to simply delete the text of the current Section 97.303(g) and to not adopt the proposed revised wording for that rule subsection set forth in Appendix D to the Notice.

Therefore, given the foregoing and the Annex 1 attached hereto, ARRL, the national association for Amateur Radio respectfully requests that the Commission timely issue a Report and Order making the LF and MF allocation changes in Part 2 and the Part 97 service rule changes which were proposed in the Notice and which were supported by ARRL herein, so as to: (1) allocate the

135.7-137.8 kHz band to the Amateur Radio Service on a secondary basis; and (2) raise the secondary Amateur Service allocation in the 1900-2000 kHz band (100 kilohertz) to primary status.

Respectfully submitted,

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ANNEX A

ANALYSIS OF COMPATIBILITY BETWEEN 135.7-137.8 kHz AMATEUR RADIO COMMUNICATIONS AND CO-CHANNEL POWER- LINE-CONTROL SYSTEMS

Prepared by the following members of the ARRL Electromagnetic Compatibility Committee,
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Abstract

The compatibility between Power Utility Transmission Line PLC (Power Line Control) Systems and Amateur Radio transmitters operating in the International 2200 meter Amateur Radio allocation (135.7-137.8 kHz) is examined. The technical operating characteristics and typical deployments of PLC Systems are outlined. This paper concludes that there is a significant potential for compatible sharing of the same spectrum between the PLC, which communicates through signals conducted by power transmission lines, and licensed radio transmitters which use signals radiated over the air.

Introduction

(PLC) is a technology used on electric power lines for control, automatic protection, communication and telemetry. PLC uses signals below 490 kHz that couple to and propagate via transmission line conductors. A typical PLC system includes a 10- to 100-watt transmitter, a transmitter coupler, powerline isolators which decouple the power transmission line from adjacent sections, a receiving coupler and a receiver.

Applications of PLC include protective relaying, telemetry, voice communications, supervisory control, etc**.** The technique of protective relaying control is used for both protection relay activation and activation veto.

PLC System Protection

The Federal Communications Commission, in its Notice of Proposed Rule Making and Order in ET Docket No. 12-338, states: "...we would only consider adding an amateur allocation [of 135.7-137.8 kHz] if we were comfortable that amateur radio and utility PLC systems could successfully co-exist in the band.". In order to analyze the potential for interaction between Part 97 Amateur Radio operations to PLC Systems, two basic parameters must be examined: the noise floor of the PLC System and the amount of signal that an amateur operation will induce onto a transmission line that is reasonably terminated for PLC operation.

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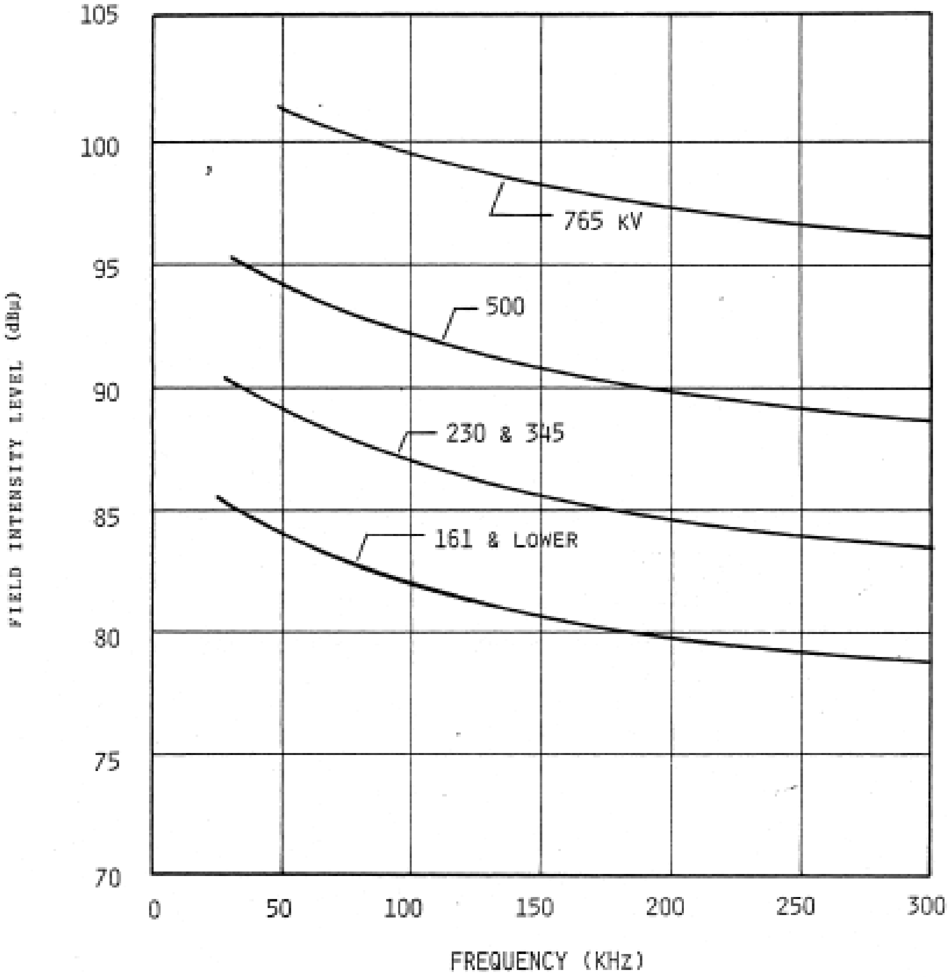

Figure 47. Field Intensity Levels From a Radio Transmitter Near a Transmission Line.

Figure 47 from NTIA TR-85-181 **[1]** *Adverse Weather Noisefloor Presented as F.I. (Field Intensity in dbu/m) versus Frequency. This shows the field intensity resulting from adverse weather present at power lines of different configurations*

Maximum Part 97 Power

In Part 97 rules, the normal method of determining the maximum power for an amateur station is by transmitter output power, but in several sections of Part 97, a maximum ERP is used to describe the maximum permissible transmitted power, e.g. the 60 meter maximum transmitted power as described in §97.313 (f) and the 611 watt ERP limitation for earth telecommand stations operating from specific locations §97.313(i).

The International power limit for Amateur Operation in the 135.7-137.8 kHz band is 1 watt E.I.R.P. (Equivalent Isotropically Radiated Power) pursuant to ITU Radio Regulations Footnote 5.67A:

5.67A *Stations in the amateur service using frequencies in the band 135.7-137.8 kHz shall not exceed a maximum radiated power of 1 W (e.i.r.p.) and shall not cause harmful interference to stations of the radionavigation service operating in countries listed in* No. 5.67. **[2]**

At a free-space distance of 1 km from the source, a 1-watt EIRP signal will present a field intensity of 5.48 mV/m (74.8 dBuV/m) **[3]** [2]**.** A field intensity of this level corresponds to a signal that is 6.4 dB below the 81.2 dBuv/m adverse- weather noise floor of a PLC system operating on a 161-kilovolt (or lower) transmission line and 23.4 dB below the adverse weather noise floor of a PLC system operating on a 765 kilovolt transmission line.

PLC System Noise Floor

The noise power induced onto a transmission line configured for PLC during adverse weather sets the noise floor of the PLC System's link budget. In footnote 45 of the NPRM and Order, the Commission notes:

> *NTIA Technical Report TR-85-181, titled "Evaluation Techniques – Fixed Service Systems to Power-Line-Carrier Circuits," U.S. Department of Commerce, Sept. 1985, at pp. 2-1, 5-77 suggests that in-band amateur service radio transmitters can operate compatibly with PLC systems if the electric field strength from the amateur service radio transmitters in the vicinity of the transmission lines does not exceed 81.2 dBμV/m.*
>
> *Specifically, using Figure 47, 81.2 dBμV/m is the threshold field intensity level for the frequency 136 kHz at which interference occurs to PLC systems on transmission lines with 161 kV and lower voltages*. **[4]**

A field intensity of 81.2 dBuV/m corresponds to the level from a 1-watt EIRP transmitter at a distance of 475 meters from the source, conservatively assuming far-field conditions.

At 1 km distance, the free-space field intensity of the 1-watt EIRP international limit is more than 6 dB lower than the interference-free operating levels determined by NTIA, thus affording sufficient protection to PLC systems from amateur transmitters operating in the 135.7-138.7 kHz band. Similarly, by limiting a transmitted Field Intensity to 74.8 dBu/m at the location of a power transmission line a transmitter operating at a distance separation less than 1 kilometer could reduce power below the 1-watt E.I.R.P level in order to achieve the needed degree of protection .

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[2] Based on the formula in Reference **[3].**

Transmitter Power Limit as an Alternative to an EIRP Limit

ITU-R Recommendation M.1732-1 describes the typical Amateur Radio emission in this 137 kHz frequency range : **[5]**

Mode of operation	Slow Morse ≤ 1 Bd CW
Frequency band (MHz)	0.136
Necessary bandwidth and class of emission (emission designator)	1H00A1B 1H00J2B
Transmitter power (dBW)	23
Transmitter line loss (dB)	0.0
Transmitting antenna gain (dBi)	–22
Typical e.i.r.p. (dBW)	1
Antenna polarization	Vertical
Receiver IF bandwidth (kHz)	0.4
Receiver noise figure (dB)	13

The Federal Communications Commission in footnote 40 of the Notice of Proposed Rule Making in Docket ET 12-338 notes that in 2002, it considered limitations on the maximum PEP (Peak Envelope Power) transmitter power output of an Amateur station in this band;

> *The Commission also stated that it believed that sharing of this spectrum would be facilitated if the amateur station is limited to an EIRP of 1 W and the transmission bandwidth is limited to 100 Hz. Because of possible difficulty in measuring the EIRP of an amateur station in this frequency range, the Commission also proposed to limit amateur transmitter output power in this band to 100 W peak envelope power (PEP). Amendment of Parts 2 and 97 of the Commission's Rules to Create a Low Frequency Allocation for the Amateur Radio Service, ET Docket* No. 02-98, *Notice of Proposed Rule Making*, FCC 02-136, 17 FCC Rcd 8954, 8963 ¶ 25 (2002) (*2003 Amateur Radio NPRM) (FCC 02-136).* **[6]**

The nature of electrically short antennas that are used at wavelengths of 2200 meters will result in low radiation efficiencies such as indicated in ITU-R Recommendation M.1732-1. A 200 watt PEP output transmitter feeding an antenna with the -22 dBi gain used as an example in M.1732-1, coupled with a matching network with significant losses required to match the transmitter to the antenna, will provide an EIRP of no more than 1 watt (0 dBW). A PEP limitation of 200 watts is consistent with the international limitation of 1 watt EIRP. If a transmitter power limit is used as a method of controlling the field intensity of licensed signals that is simple to calculate, this limit should be calculated considering the definition of PEP in the FCC Rules (47 CFR § 2.1(c)).

Conclusions

The NTIA TR-85-181 Study has approached the compatibility of PLC systems and relatively high-powered licensed transmitters operating in the same frequency range as PLC systems. When the methodology of that study is applied to proposed amateur allocations near 136 kHz, the potential for interference is determined to be very low and only for amateur stations that may be located closer than 1 km to an existing transmission line. At distances of 1 kilometer or greater amateur operation at the 1-watt EIRP level, will be at least 6 dB lower than the field intensity that the NTIA determined would allow PLC systems to function reliably in the presence of licensed emitters. The same 6 dB margin can be achieved at distances closer than 1 kilometer by limiting the transmitted Field Intensity to 74.8 dBu/m at the location of a power transmission line. In this context it is noted that Section 15.3(t) of the Commission's Rules permits PLC systems to operate only on transmission lines, which are defined so as to *exclude* those electric lines which connect the distribution substation to the customer or house wiring.

This 6 dB safety margin is based on worst-case assumptions. The polarization difference between typical amateur vertical antennas that will be used on this band and horizontally configured power lines will provide an additional but indeterminate margin of interference protection.

Based on the NTIA Study TR-85-181, amateur operation at the 1W EIRP level will not cause interference to PLC systems used on transmission lines as defined in Section 15.3(t) of the Commission's Rules which are operating within the 135.7-137.8 kHz band, provided that separation distances from the Amateur station exceeds 1 km. from the PLC-carrying transmission line.

References

[1] Andrew Farrar et al., Evaluation Techniques—Fixed Service Systems to Power-Line-Carrier Circuits, NTIA Report 85-181 (1985).

[2] ITU Radio Regulations, Edition of 2012, No. 5.67A.

[3] National Telecommunications and Information Administration, Manual of Requirements and Procedures for Federal Radio Frequency Management, May 2010 revision of the 2008 edition, at 10.20.

[4] *Notice of Proposed Rule Making*, FCC 12-140A1, FCC Rcd. (released November 19, 2012), ET Docket 12-338, n.45

[5] ITU-R Recommendation M.1732-1, "Characteristics of systems operating in the amateur and amateur-satellite services for use in sharing studies", 03/2012, Table 1, at 3.

[6] *Notice of Proposed Rule Making*, *supra*, n.40.